

### Claims

We claim:

1. A method for coding video data contained in image frames comprising the steps of:  
downscaling said video data image frames;  
encoding said downscaled video data to produce base layer frames;  
generating quality enhanced residual images from said downscaled video data and said base layer frames;  
encoding said quality enhanced residual images using a fine granular coding technique to produce quality enhancement layer frames;  
upsampling said base layer and said quality enhanced residual frames;  
generating a first set of residual images from said upsampled encoded data contained base layer, and corresponding quality enhancement layer frames and said video data;  
encoding said first set of residual images using a fine granular coding technique to produce spatial enhancement layer frames.
2. The method as recited in claim 1 further comprising the step of;  
generating a second set of residual images from said first set of residual images; and  
coding said second set of residual images using a fine granular coding technique to produce temporal enhancement layer frames.

3. The method as recited in claim 1, further comprising the step of:  
transmitting said base layer frames, and portions of said spatial enhancement frames  
over a variable bandwidth network.
4. The method as recited in claim 3 further comprising the steps of:  
determining an available bandwidth of said network;  
selecting the portions of said spatial enhancement layer frames to be transmitted  
based on said available bandwidth.
5. The method as recited in claim 3, further comprising the step of:  
transmitting portions of said temporal enhancement layer frames over a variable  
bandwidth network.
6. The method as recited in claim 5 further comprising the steps of:  
determining an available bandwidth of said network;  
selecting the portions of said temporal enhancement layer frames to be transmitted  
based on said available bandwidth.
7. The method as recited in claim 1 further comprises the step of:  
combing said quality enhancement frames and said spatial enhancement layer frames  
into an enhancement frame layer.

8. The method as recited in claim 7 further comprises the step of:

transmitting said base layer frames and portions of said combined quality enhancement layer frames and said spatial enhancement layer frames over a variable bandwidth network.

9. The method as recited in claim 8 further includes determining an available bandwidth of the network; and

selecting portions of said quality enhancement layer and portions of said spatial layer frames to be transmitted based on said available bandwidth.

10. The method as recited in claim 8 further comprises the step of:

combining said enhancement layer frame and said temporal enhancement layer frames into a second enhancement frame layer.

11. The method as recited in claim 10 further comprises the step of:

transmitting said base layer frames and portions of said combined quality enhancement layer frames, spatial enhancement layer frames and temporal enhancement layer frames over a variable bandwidth network.

12. The method as recited in claim 11 further includes determining an available bandwidth of the network; and

selecting portions of said quality enhancement layer and portions of said spatial layer frames to be transmitted based on said available bandwidth.

13. The method as recited in claim 1 wherein said spatial enhancement layer frames are motion compensated.

14. The method as recited in claim 2 wherein said temporal enhancement layer frames are motion compensated.

15. A method for coding video data comprising the steps of:

downscaling said video data;

coding said downsampled video data to produce base layer frames;

generating residual images from said downsampled video data and said base layer frames;

coding said residual images using a fine granular coding technique to produce quality enhancement layer frames;

upsampling said base layer and said quality enhancement layer frames

generating a second set of residual images from upsampled base layer and said quality enhancement frames and said video data;

coding said second residual images using a fine granular coding technique to produce spatial enhancement layer frames.

16. The method as recited in claim 15 further comprising the steps of:

generating a third set of residual images from corresponding spatial layers; and

coding said third set of residual images using a fine granular coding technique to produce temporal enhancement layer frames.

17. The method as recited in claim 15 wherein said spatial enhancement layer frames are motion compensated.

18. The method as recited in claim 16 wherein said temporal enhancement layer frames are motion compensated.

19. A memory medium including code for encoding video data, said code comprising:

- code to downscale said video data;
- code to encode said downsampled video data to produce base layer frames;
- code to generate residual images from said downsampled video data and said base layer to produce quality enhancement frames;
- code to upscale said base layer frames and said quality enhancement layer frames;
- code to generate a second residual images from upsampled frames and said video data;

and

- code to encode said second residual images using a fine granular coding technique to produce spatial enhancement layer frames.

20. A memory medium as recited in claim 19 further comprising:

- code to generate a third residual images from said spatial enhancement frames;

code to encode said third residual images using a fine granular coding technique to produce temporal enhancement layer frames.

21. A memory medium as recited in claim 19 wherein said spatial enhancement frames are motion compensated.

22. A memory medium as recited in claim 20 wherein said temporal enhancement layer frames are motion compensated.

23. An apparatus for coding video data contained in image frames comprising:

- a downscaler to downscale said video data image frames;
- an encoder operable to:
  - encode said downsampled video data to produce base layer frames;
  - generate quality enhanced residual images from said downsampled video data and said base layer frames;
  - encode said quality enhanced residual images using a fine granular coding technique to produce quality enhancement frames
- an upscaler to upscale said base layer and said quality enhanced residual images;
- a second encoder operable to:
  - generate a first set of residual images from said upsampled base layer, said upsampled residual images and said video data;
  - encode said first set of residual images using a fine granular coding technique to produce spatial enhancement layer frames.

24. The apparatus as recited in claim 23 wherein said second encoder is further operable to:

generate a second set of residual images from said first set of residual images; and  
encode said second set of residual images using a fine granular coding technique to produce temporal enhancement layer frames.

25. The apparatus as recited in claim 23, further comprising  
a transmitting device to transmit said base layer frames, and portions of said spatial enhancement frames over a variable bandwidth network.

26. The apparatus as recited in claim 25 further operable to:  
determine an available bandwidth of said network;  
select portions of said spatial enhancement frames to be transmitted based on said available bandwidth.

27. The apparatus as recited in claim 25, further operable to:  
transmit portions of said temporal enhancement layer frames over a variable bandwidth network.

28. The apparatus as recited in claim 27 further operable to:  
determine an available bandwidth of said network;

select portions of said temporal enhancement layer frames to be transmitted based on said available bandwidth.

29. The apparatus as recited in claim 23 further operable to:

combine said quality enhancement layer frames and said spatial enhancement layer frames into a combined enhancement layer frame.

30. The apparatus as recited in claim 29 further operable to:

transmit said base layer frames and portions of said combined enhancement layer frames over a variable bandwidth network.

31. The apparatus as recited in claim 27 further operable to:

determine an available bandwidth of the network; and  
select portions of said quality enhancement layer and portions of said spatial layer frames to be transmitted based on said available bandwidth.

32. The apparatus as recited in claim 30 further operable to:

combine said enhancement frame layer and said temporal enhancement layer frames into a second enhancement layer frame.



33. The apparatus as recited in claim 32 further operable to:  
transmit said base layer frames and portions of said combined quality enhancement frames, spatial enhancement frames and temporal enhancement frames over a variable bandwidth network.
34. The apparatus as recited in claim 33 further operable to  
determine an available bandwidth of the network; and  
select portions of said quality enhancement layer and portions of said spatial layer frames to be transmitted based on said available bandwidth.
35. The apparatus as recited in claim 27 wherein said spatial enhancement layer frames are motion compensated.
36. The apparatus as recited in claim 28 wherein said temporal enhancement layer frames are motion compensated.
37. A method for coding video data comprising the steps of:  
downscaling said video data;  
coding said downscaled video data to produce base layer frames;  
generating residual images from among said base layer frames;  
coding said residual images using a fine granular coding technique to produce first temporal enhancement layer frames

generating residual images from said downsampled video data and said base layer frames;

coding said residual images using a fine granular coding technique to produce quality enhancement frames;

upsampling said base layer and said quality enhancement layer frames

generating a second set of residual images from said upsampled base layer and said quality enhancement layer frames and said video data;

coding said second residual images using a fine granular coding technique to produce spatial enhancement layer frames.

38. The method as recited in claim 37 further comprising the steps of:

generating a third set of residual images from among corresponding spatial layers;

and

coding said third set of residual images using a fine granular coding technique to produce second temporal enhancement layer frames.

39. The method as recited in claim 37 further comprises the step of:

transmitting said base layer frames and portions of said combined quality enhancement layer frames, said spatial enhancement frames and said first temporal enhancement layer frames over a variable bandwidth network.

40. The method as recited in claim 38 further comprises the step of:  
transmitting said base layer frames and portions of said combined quality enhancement frames, said spatial enhancement frames, said first temporal and said second temporal enhancement layer frames over a variable bandwidth network.
41. The method as recited in claim 37 wherein said spatial enhancement layer frames are motion compensated.
42. The method as recited in claim 38 wherein said temporal enhancement layer frames are motion compensated.
43. A system for coding video data comprising:  
means for downscaling said video data;  
means for coding said downscaled video data to produce base layer frames;  
means for generating residual images from said downscaled video data and said base layer frames;  
means for coding said residual images to produce quality enhancement frames;  
means for upscaling said base layer and said quality enhancement frames  
means for generating a second set of residual images from upscaled base layer and said quality enhancement frames and said video data;  
means for coding said second residual images to produce spatial enhancement layer frames.

44. The system as recited in claim 43 further comprising:  
means for generating a third set of residual images from corresponding spatial layers;  
and  
means for coding said third set of residual images to produce temporal enhancement layer frames.

45. The system as recited in claim 43 wherein said means for coding includes FGS encoding.

46. The system as recited in claim 44 wherein said means for coding includes FGS encoding.